

**Problem 1 (4 points):** [GH 3.2.31] *In the early to mid 1900s, New York City loan sharks would loan \$4 at the beginning of the week to be repaid with \$5 at the end of the week. What annual rate of simple interest did the loan sharks charge?*

**Solution:** We recall the simple interest future value formula  $F = P(1 + rt)$ . We wish to find the annual interest rate  $r$  given a present value of 4, a future value of 5, and a time of  $7/365$ . We thus solve

$$5 = 4 \left( 1 + r \left( \frac{7}{365} \right) \right)$$

for the annual interest rate  $r$ , finding

$$r = \frac{\frac{5}{4} - 1}{\frac{7}{365}} = \frac{365}{28} \approx 13.0357.$$

We conclude the loan sharks charged a 1303.57% annual rate of simple interest. We observe that this seems to be a ridiculously large rate, but so is paying 25% interest in a week's time, so we don't disbelieve our answer.

**Problem 2 (6 points):** [GH 3.3.46] *If a deposit is made into an account earning 6% interest compounded monthly, how long will it take the amount in the account to triple in value? Hint: The answer doesn't depend on the amount of the initial deposit.*

**Solution:** We recall the compound interest formula  $F = P \left( 1 + \frac{r}{n} \right)^{nt}$ . We wish to find the time  $t$  given a principal of  $A$ , a future value of  $3A$ , an annual interest rate of 6%, and 12 periods per year. We thus solve

$$3A = A \left( 1 + \frac{.06}{12} \right)^{12t}.$$

Dividing both sides by  $A$  and simplifying the quantity in the parentheses, we obtain

$$3 = (1.005)^{12t}.$$

Taking the logarithm of both sides and moving the exponent down, we obtain

$$\log 3 = 12t \log 1.005.$$

Dividing both sides by  $12 \log 1.005$ , we find

$$t = \frac{\log 3}{12 \log 1.005} \approx 18.3559.$$

It thus takes 18 years and 5 months for the account to triple in value.

**Problem 3 (0 points):** *What has been the rate of inflation in the United States since 2000, i.e., from 2000 to 2006? Answer as a percentage to two decimal points.*

**Solution:** From <http://www.measuringworth.com/inflation/>, an annual inflation rate of 2.66%. From <http://www.inflationdata.com>, an annual inflation rate of 3.07%.